DOCUMENT RESUME

ED 125 630 IR 003 718

AUTHOR Bushnell, David S.
TITLE The Impact of Instructional Technology on Training in the U.S. Army.
INSTITUTION Human Resources Research Organization, Alexandria, Va.
PUB DATE Jul 76
NOTE 15p.; Paper presented at the International Learning Technology Congress and Exposition on Applied Learning Technology for Human Resource Development (Washington, D.C., July 21-23, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Behavioral Science Research; Cost Effectiveness; *Educational Programs; Instructional Design; *Instructional Improvement; *Instructional Technology; Manpower Development; *Military Training; Program Effectiveness; Program Evaluation; Training Techniques
IDENTIFIERS Army; Human Resources Research Organization; HumRRO

ABSTRACT

The Human Resources Research Organization (HumRRO) has applied human factors and behavioral science principles to improve the training and performance of Army personnel. Military training now emphasizes decentralized decision-making, use of individualized instruction, and increased flexibility in training approaches. Research conducted by HumRRO has resulted in the development of a generalizable procedure for structuring training sequences and organizing and evaluating training programs. (CH)

The Impact of Instructional Technology on Training in the U.S. Army

by

David S. Bushnell
Human Resources Research Organization

Almost two years ago, former Secretary of Defense James Schlesinger noted that military training expenditures exceeded $6 billion annually and involved no less than 1/6 of all military personnel at any given time (1). Recognizing the Defense Department's heavy investment in manpower, Schlesinger requested that a Task Force on Training Technology be convened and given the responsibility of evaluating the effectiveness of DOD training. Their objective: to recommend ways of reducing costs and increasing effectiveness of DOD training.

Working over a 12 month interval, from July 1974 to June 1975, the Task Force concluded that too few dollars were being expended on R&D training technology (0.05% of the total DOD research outlay) and that, even with this relatively small investment, considerable progress had been made in promoting cost-effective training (2). Furthermore, they observed that "the Services have pioneered (a) in the use of complex simulators to train personnel to operate and maintain major weapons systems, (b) in self-paced personalized methods of instruction, (c) in performance-oriented training, and (d) in managing the training of very large numbers of individuals" (3). But, they observe, insufficient attention is being given to collective training, that is, the training of crews, groups, teams, and units at a decentralized level. These same sentiments were reiterated four months later when, at the 8th NTEC and Industry Conference in Orlando, Florida, Army Major General Paul Gorman, Deputy Chief of Staff for Training, told attendees that "... in this year of 1975, the Captains of the United States Army and the Marine Corps face challenges beyond any that gents of their rank have ever faced in combat in the history of the United States." He then went on to say that both the Army's officers and its enlisted men will be required to make increasingly critical decisions within shorter periods of time (4). The growing complexity of our weapon systems demands sophisticated training programs where simulated engagement exercises are used to polish decision-making skills. The effective operation and maintenance of today's weapon systems

requires increasingly able and experienced personnel. How the Army has responded to these demands for improved training programs since World War II is a story well worth the telling.

When Dr. Scanland wrote me several months ago to present a paper on this topic at this first International Learning Technology Congress, I was delighted to do so. In his own persuasive manner, Dr. Scanland asked if I would like to address myself to the advances that my organization, Human Resources Research Organization (HumRRO), has contributed to Army training over the last 25 years through research and development. As if this weren't enough, he then sweetened the pot by inviting me to, in turn, invite 3 or 4 of my own colleagues to prepare backup papers further detailing HumRRO's close working relationship with the Army and contributions in specific areas. To top it off, he offered to publish all four papers as part of the proceedings of this Conference. Thus, much of what follows draws heavily upon the contributions of my colleagues with the caveat that some of the rasher generalizations which I make later on in my talk are uniquely my own and do not necessarily reflect the views of HumRRO or my associates.

For a more complete and carefully reasoned statement of specific HumRRO experiences touched on briefly here, I refer you to Mr. Lavisky's historical review of Army research on training, Drs. McFann and Taylor's discussion of a development of performance-oriented training, and Dr. Caro's review of research on the use of simulators in pilot training.

Since 1951, HumRRO scientists have been discovering, developing and applying human factors and behavioral science principles to the improvement of training and individual performance of Army personnel. Perhaps the best way for me to give you a "feel" for the impact that our research and development program has had on the Army, would be for me to briefly describe Army developments in (1) basic combat training, (2) advanced training, (3) support training, and (4) flight training over the last 35 years. I will conclude my remarks by attempting to identify for you some of the seminal forces

which have helped to bring about these needed improvements in training technology. Since the outbreak of World War II, I think you will agree that dramatic progress has been made.

Mr. Lavisky in his companion paper "Army Research on Training: How it All Began," observes that before World War II, Army training was decentralized, highly personalized, and unstandardized. Because of the small number of enlistees each year, recruits were trained within the regiment which they joined and were likely to remain with that regiment until discharge. Performance standards were set by the regimental commander. Let me underscore two key terms I just used -- decentralized and highly personalized -- those are terms that will pop up again in our discussion. I think it is a reasonably safe observation that before the onset of our involvement in World War II, both the Army and Navy, but particularly the Army, were faced with limited dollars for training with the apprenticeship model serving as the principle guide. This status reflected the failure of the military to involve American psychologists and other behavioral scientists in military problems between World War I and II with the possible exception of the improvement of the personnel selection system (5).

Then, in 1939, the Army was forced to change its approach to training in order to accommodate the masses of soldiers brought into the Service through mobilization. Between 1939 and 1941, for example, three incomplete Infantry Divisions grew to thirty Infantry Divisions backed up by six Armored Divisions. The training model employed was not developed through research, but essentially followed the traditional lecture-oriented, information-centered, time-constrained approach found in most colleges and public schools at that time. The "pointer/podium/poop" approach to Army training was the product of three factors:

1. The need to train a large number of officers to be used subsequently involved in the training of enlisted personnel resulted in a heavy reliance on the traditional lecture method. Such a model was adopted by default. No other learning approach was around to compete with it.

2. The rapid build up of forces put pressure on military leaders to standardize subject matter content through the adoption of field manuals as the focal point of training. Since such manuals were organized around subject matter, the training itself was necessarily focused on subject matter. Visual aids were extensively used, putting even greater emphasis on passive listening rather than active involvement in the learning process.
3. The time available for training and the sequence of the subject matter were also standardized. Before then, each company, troop, or battery had its own training schedule determined largely by the Unit Commander's evaluation of needs and time constraints. Eventually, however, greater efficiency and better coordination was realized through standardizing not only the order of subjects to be taught, but the amount of time devoted to each subject as well (6).

It would be inaccurate, however, to characterize basic training as totally lacking in the improvement of performance skills. Target shooting and close order drill were common events. Extensive use of Army maneuvers with simulated battle sounds and conditions was used to help condition Army units to combat. Few among us will forget that day we were required to crawl on our bellies with a full pack under a blanket of live machine gun bullets. We learned to keep our heads down.

Following World War II, the high cost of ammunition together with mounting evidence that basic training as constituted during the war years had a negative effect on recruit attitudes toward the Army, resulted in Army Training Centers adopting a new set of procedures directed at increasing the trainees' identification with his unit and with the Army. It was about this time that the Human Resources Research Office (HumRRO) began to contribute to the improvement of basic training through the application of behavioral and social science concepts.

The Army's Adjutant General's Office, with its primary responsibility for the improvement of personnel selection and placement, continued to focus

much of its attention on testing after the war. In 1947, a small cadre of personnel researchers turned their attention to measuring the results of basic training and of career schooling. By 1950, the Army began to recognize that it was not keeping pace with either the Navy or the Air Force in sponsoring or benefiting from research on the improvement of human performance. A staff study memo dated June 22, 1950 states: "The annual budget allocations for research in human resources in the Department of the Army has been 1% or less of the total research and development budget for the entire Department of the Army." The upshot of this and other staff studies resulted in the Army contracting with the George Washington University for the establishment of HumRRO. Its goals, as shaped by Dr. Harry Harlow, at that time the Army's Chief Psychologist, were threefold:

1. To conduct research in the areas of training methods, motivation and morale, and psychological warfare techniques.
2. To set up a civilian research staff at a central location empowered to grant and monitor contracts to educational, business, and industrial organizations as well as provide technical supervision of research conducted at military installations.
3. To establish in-service research units at appropriate military installations who were, in turn, directed to work with HumRRO's staff on a collaborative basis.

During the first four years of HumRRO effort, we learned that the training context provided the most productive area of focus in attacking morale, motivation, leadership and training problems. Research goals were specified in an Annual Work Program initially agreed upon by the Army and HumRRO. Organizationally, three research divisions, the Director's office, and supporting services were initially located on the University's campus and later in Alexandria, Virginia. By 1958, five field divisions had been formed and co-located with military research units at major Army installations throughout the country. Almost from the beginning, the HumRRO research staff was

augmented by Army personnel located at the field division sites or detailed for work at corporate headquarters in Alexandria, Virginia.

Basic Combat Training (BCT)

Among the first series of studies conducted by HumRRO was an evaluation of the impact of basic training on Army recruits (see, for example, 7 and 8). One of the more significant products of that research, aimed at increasing the recruit's identification with his unit and with the Army, was the establishment of a five-week training program for Army Drill Sergeants. A four-man HumRRO team worked for several months with Army training personnel to develop a training program which would help the Drill Sergeant learn more about motivating recruits, developing trainee skills, and building esprit de corps. Please note that HumRRO personnel did not design such a training program in isolation, but spent several months in close collaboration with Army training personnel. Subsequently, Army Drill Sergeant schools were established at a number of Army installations.

Another major change in recruit training came about in 1957 when the Army adopted a rifleman training procedure (both for use during the day and at night) which put stress upon first studying and then simulating the combat rifleman's job. Before that, marksmanship skills were developed by having a recruit fire at bull's-eye targets at known distances just as he might in competitive marksmanship matches. Under the new procedure (9), the trainee was taught to spot and estimate the distance of a pop-up silhouette target (dubbed Punchy Pete) which dropped when it was hit. Night firing marksmanship programs, based on the concept of aligning the rifle without using its sights, resulted in a 60% to 210% increase in accuracy over previous training methods. Here again, HumRRO researchers worked on-site at all of the major Army training locations, including Forts Knox, Benning, Rucker, Bliss and Ord and, later on, at Fort Hood. Studies were also conducted in the field at a variety of Army operational sites including Europe, Korea, and Viet Nam. Close collaboration with military personnel helped to ensure adoption and implementation of recommendations derived from the research.

Most of the BCT studies (and subsequent efforts) had as their origin a specific, operational problem. Every effort was then made to generalize the finding to other comparable situations. Thus the value and utility of HumRRO work tended to follow an experimental curve of usefulness over time. The degree of success achieved in solving problems was thought to be a function of timeliness, changes in Army priorities (compatibility with established practices), skill in communicating results to key decision makers, and characteristics of the innovation itself, e.g., its obvious advantage over older practices in terms of efficiency (10). Our close proximity to and collaboration with Army personnel helped gain acceptance for our findings and recommendations as well as establish the credibility of the HumRRO effort.

One dramatic illustration of this occurred in 1966 when the Army adopted a service-wide regulation (CONARC Reg 350-100-1) which was used to guide the development of all training programs between 1966 and 1971. This "systems engineering" approach required that precise behavioral objectives for training be developed through careful job analysis and that the specific subject matter selected for the training program be included on the basis of its relevance to the tasks to be performed. Criterion-referenced tests designed to assess individual mastery of various performance objectives were also introduced (11). Thus up to 1966, HumRRO's integrated research and development program not only focused on improving basic training, but it was equally concerned with job analysis and evaluation procedures, the improvement of instructional methods, and with developing a better understanding of the learning styles and characteristics of trainees. Testing and evaluation procedures developed at the same time helped to ensure that the basic recruit upon completion of basic training could perform the necessary skills and could demonstrate that he had the knowledge required of a foot soldier.

Advanced Training

Even with these advances, much remained to be done in the areas of Advanced Individual Training (AIT) and Support Training (ST). The pattern

adopted during World War II of lecture centered, standardized courses oriented to group instruction persisted in the classroom. Even in the periodic renewal of manual skills such as rifle firing, little attention was given to more optimal schedules of reinforcement designed to maximize skill retention. Fortunately, outside the classroom, a number of exceptions occurred.

After completion of BCT, a recruit was often assigned to rifle squad training where techniques of fire and patrolling skills were taught, based on HumRRO analyses of what a soldier must know and do in actual combat (12). In addition, eight fundamental night-operation skills were taught. These too, were derived from field observations by HumRRO scientists (13).

Had the BCT graduate been assigned to other AIT programs such as Armor or Air Defense, he would have been presented with on-the-job aids in a functional context. Here the material to be learned was broken down into a step-by-step procedure with specific instructional techniques for use by recently graduated peer instructors. Air Defense missile gunners were taught to recognize enemy aircraft through a procedure developed by HumRRO personnel (14). The Combat Development Command recommended that this prototype program be adopted for training all forward-area air defense gunners.

Support Training

Recruits graduating from basic training were also assigned to non-combat roles in what were called "support" positions. Radio operators, medical corpsmen, supplymen and cooks all benefited from research on how to formulate training objectives, select course content, and alternative instructional methods and procedures (aimed at increasing training efficiency and reducing attrition). This "systems engineering approach" resulted in a 10% to 15% reduction in training time while maintaining or enhancing the performance of graduates.

In 1966, a major new recruitment policy was adopted by all the Services. They agreed to dramatically increase the number of lower mental ability recruits accepted into military service. HumRRO was asked to undertake a

series of studies to determine what effect this policy would have on the training and utilization of personnel in the Army. It was feared that the Army's continued reliance upon passive classroom lecture and paper and pencil (normative) tests would prove to be ineffective with lower mental ability personnel.

Shortly thereafter, college deferrals were abandoned. The resulting heterogeneity of recruits demanded an even more flexible form of instruction. Between 1968 and 1972 the HumRRO R&D effort focused on devising instructional approaches which would accommodate widely varying aptitude levels. As an example of how this series of new studies were organized, let me describe in somewhat more detail for you a recent systems engineering effort of eight Combat Arms Military Occupational Speciality Codes (MOSs). The Combat Arms Training Board (CATB) of the Army had discovered that those responsible for training operational units needed assistance in increasing the proficiency level of their non-commissioned officers. Trainers at the unit level had neither the methodology nor the material to conduct adequate training. The combat arms soldiers were also complaining that they had little chance to develop their skills beyond the rudimentary level. The first step taken in solving this problem was to attempt a simultaneous systems engineering of 8 Combat Arms MOSs. We were able to take advantage of the tasks' commonalities that existed between various duty positions. In this way the training could be made more efficient if common tasks were identified and training materials developed once rather than several times by different combat arms trainers.

In this clustering study, 93 different duty positions were identified and task inventories developed on each. A classification system was used to permit comparison of the material from each position. The tasks were identified by category, such as first aid, land navigation, and tactics. Within each category tasks were then broken into three levels: (1) fundamental or those tasks expected to be common to all soldiers in the Army; (2) branch or those tasks expected to be common to duty positions in a given branch; and (3) MOS or those tasks associated with specific duty positions. Task descriptions were validated by three different groups: job incumbents, senior NCOs and officers. Job task data, e.g., job conditions, knowledge and skill

[illegible] were developed for all tasks that were performed by 60% or more of the job incumbents. That information was then used to develop training objectives, training materials, reference manuals, evaluation criteria, and MOS test questions. The information thus developed proved to be an important input for curriculum planners, training administrators, and training developers at each of the Combat Arms Schools. This required a whale of a lot of coordination between the Army, three HumRRO research divisions, and CATB (15).

Emerging out of the mass of recent research on the training process are six principles which deserve to be recapitulated here. They are:

1. Performance-based instruction. Student learns the skills necessary for job performance. Emphasis is on active skill practice, "doing" rather than "passive" absorption of information.
2. Task mastery. Every student is required to reach a standard of performance in each skill. Assessment is on a "go/no-go" basis. The student who does not reach the criterion level of performance receives additional practice until he does reach it.
3. Functional context. The student learns in a job-relevant situation. Theoretical or technical material is presented only when it is needed in learning to perform a skill.
4. Individualization. For various reasons people learn at different rates. To the extent possible, the trainee is permitted to learn a skill at his own rate.
5. Feedback. If the instructor and curriculum developer knows a good deal about the student to be taught, instructional methods can be modified to be more effective. If the student knows about his own skill acquisition, he is motivated to correct errors of inadequate performance.
6. Quality control. To ascertain that the training system is functioning properly, student performance must be systematically assessed at various times during and at the end of training.

Flight Training

Before I bring my remarks to a close, I would like to comment on one other area of HumRRO research effort: the training of helicopter pilots. As everyone knows, aviation training is costly. The high cost of fuel combined with the increasing value and complexity of Army aircraft led HumRRO to propose to the Army that it attempt to improve its evaluation of pilot performance and to employ less costly flight trainers in teaching maneuvers. As a result of this research, the Army helicopter trainee gets his first taste of rotary-wing flight in a helicopter training device. Men trained on this device experienced significantly less attrition during the subsequent flight training -- only 10% attrition compared with 30% attrition under previous procedures -- and they make better grades and soloed earlier (16).

Paul Caro's excellent review of research on the role of simulators in pilot training explores those factors which influence the transfer of simulated training to operational aircraft. Six factors were shown as having significant impact on simulator training effectiveness. Simulator design, visual fidelity, motion fidelity, handling characteristics, etc. were judged from the vantage point of their influence upon training effectiveness. Other variables such as the sequence of instruction employed, individual vs. group pacing, training to specified criterion levels, and length of exposure to training on a simulator all need investigation if the proper combination of hardware, training program, and personnel was to be ascertained. Caro concluded that while simulator training artisans can sometimes produce spectacular results, there are too few such individuals to develop and continuously update all of the simulator training programs required by military and civilian pilot training establishments and operational units. He concludes his paper with a plea for more case study reports of simulator training applications so that conceptual models might be developed for future applications and research. Gathering data on existing simulators and training programs would, he argues, provide a broad data base for judging the

effectiveness of simulator training. Through this approach extensive savings might be realized through designing simulators to meet training specifications. One such device, whose commercial procurement costs would have been about $75,000, was fabricated by the Army to HumRRO specifications at a cost of less than $5,000.

Summary and Conclusion

What began as a decentralized, somewhat individualized and unstandardized approach to pre-World War II training has come full circle. While it would be misleading to characterize today's training principles as identical with those followed during the period between 1918-1939, they are parallel in the sense that greater emphasis is now being placed on decentralized decision-making, expanded use of self-paced and individualized instruction, and greater flexibility in training approach. What has emerged from a sustained period of research and development is a more pragmatic, sophisticated approach to the orderly development of Army training. Starting with a careful and detailed analysis of a particular job function and progressing step by step through the specification of needed knowledges and skills to the determination of training objectives and the organization and evaluation of the training program, HumRRO has helped to create a generalizable procedure that has proved to be of considerable value as new training tasks are undertaken.

In closing, it should be recognized that the procedures just outlined are only as good as the learning theory upon which they are based. The interaction between theory and empirical observation, coupled with the involvement of military personnel in priority setting and the implementation of results, has resulted in an unusually productive and beneficial relationship.

REFERENCES

1. Schlesinger, James R. Annual Defense Department Report, FY1975, pp. 197-198.

2. Defense Science Board, Summary Report of the Task Force on Training Technology, June 1975, pp. iv-v.

3. Ibid. pg. v.

4. Gorman, Maj Gen Paul C. "Remarks at 8th NTEC & Industry Conference," "The Center Line". December 11, 1975, pg. 11.

5. Melton, Arthur W. "Military Psychology in the United States of America," American Psychologist, 1957., pps. 740-746.

6. Ford, J. Patrick, "Now Hear This," Training in Business and Industry, February, 1976.

7. Snyder, Richard. Some Problems of Basic Training Effectiveness, HumRRO Interim Report, September 1954.

8. Christie, Richard. Transition from Civilian to Army Life, HumRRO Technical Report 13, October 1959.

9. Hammes, John A., Kelly, Henry E., McFann, Howard F., and Ward, Joseph S, TAINFIRE II: A New Course in Basic Techniques of Fire and Squad Tactics, HumRRO Technical Report 41, July 1957.

10. McClelland, William A., The Process of Effecting Change, HumRRO Professional Paper 32-68, October, 1968 (based on his presidential address to The American Psychological Association's Division of Military Psychology in September, 1968).

11. Crawford, Meredith P. "Concepts of Training," in Gagne, Robert M. (ed) Psychological Principles in System Development. New York; Halt, Rhinehart and Winston, 1962.

12. Ward, Joseph S. and Fooks, N.I. Development of Improved Rifle Squad Tactical and Patrolling Programs for the Light Weapons Infantryman, HumRRO Technical Report 65-16, December 1965.

13. Nichols, Thomas F. and Powers, Theodore R. Moonlight and Night Visibility, HumRRO Research Memorandum, January 1964.

14. Whitmore, Paul G., Cox, John A., and Friel, Don J. A Classroom Method of Training Aircraft Recognition, HumRRO Technical Report 68-1, January 1968.

15. Taylor, John E., et al, Establishing the Concepts and Techniques of Performance-Oriented Training in Army Training Centers: A Summary Report, HumRRO Technical Report 75-21, June 1975.

16. Caro, Paul W., Jr., Isley, Robert N., and Jolley, Oran B. The Captive Helicopter as a Training Device: Experimental Evaluation of a Concept. HumRRO Technical Report 68-9, June 1968.